Report Summary

Protocol Development for Demand Response Calculation

The California Energy Commission has sponsored the development of a standardized measurement and verification protocol for use in calculating demand reductions by participants in Demand Response programs[1]. The protocol provides different methods to estimate the baseline electricity load profile for different types of customer load, against which peak load reductions can be calculated. The baseline electricity load profile is estimated using historical and current meter data, and represents the load that would be expected to occur in the absence of a curtailment request. The protocol may be used for price or emergency based programs that require customer-specific load reduction estimates as a basis for determining payments or incentives. Completion of the protocol is aimed at increasing small and medium-sized customer participation in demand response programs by (1) reducing the barriers related to inconsistency and confusion about how peak savings will be calculated and (2) ensuring that only real and verifiable peak load reductions receive payments.

The development of this standard peak savings protocol was based on interviews with stakeholders in several different jurisdictions and states and statistical testing of several alternative protocols for baseline load estimation. The analysis process used hourly load data from several hundred commercial and industrial customers. The study also proposes terminology for describing baseline calculation methods.

This work is intended to provide the foundation for a revised protocol that may be adopted as part of the International Performance Measurement and Verification Protocol. The IPMVP organization has participated in the development of this report and recommendations. The goal of this report is to establish a clear vocabulary for use in describing the methods used to estimate peak load reductions delivered in response to emergency or price conditions for use in future state or regional protocols. The report also offers guidelines on good estimation practice and the pros and cons of alternative peak savings calculation methods.

CRITERIA FOR SELECTING A GOOD BASELINE METHOD

Criteria that were balanced in developing a method to estimate baselines and peak savings include:

- **Simplicity**, including ease of use, ease of understanding, and low costs for participant and operator to calculate the baseline load profile and resulting savings.
- **Accuracy**, including lack of bias (i.e., no systematic tendency to over- or under-state reductions), appropriate handling of weather-sensitive accounts, and verifiability

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[1] This report was prepared by KEMA-Xenergy consulting for staff of the California Energy Commission. Copies of the report can be downloaded from the Commission's website at www.energy.ca.gov/demandresponse.

- **Minimization** of the ability for customers to game or inflate their baseline load profile
- **Predictability,** or the ability for customers to know the baseline before committing to a particular curtailment amount and event
- **Consistency** with other peak saving methods used by utilities and independent system operators

As a result of the analysis of customer data sets, it was decided the protocol should:

- allow for calculation options that recognize different customer and building circumstances
- favor simple calculation methods if the potential accuracy gains of from more complex methods appear to be slight
- indicate alternatives and trade-offs with respect to the selection criteria

Recommendations

Offering Options

Baseline calculation protocols used for demand response programs should allow the program administrator to select the most appropriate method based on each customer's load type and operating practices. One way to simplify the provision of options is to establish a default calculation method for all programs or building types and then allow certain deviations in the method for special types of customer accounts.

The basis for the selection of a method should include the customer's business type, historical load patterns, and operating practices. For example, a customer who indicates a desire to be able to cancel a work shift in advance of the control period should have access to a baseline calculation method that does not distort the estimated baseline because of this practice.

At the same time, the program administrator should have some discretion to bar customers from using a calculation approach that they appear to have manipulated in the past. Thus, if there is evidence that a particular customer tends to inflate load after notification, beyond what would reasonably be expected for pre-cooling, that customer might not be allowed to use a method that includes an adjustment to the average load profile based on energy use in pre-curtailment hours.

Practical Default and Alternative Baseline Calculation Methods

The baseline calculation method found to work best for a range of load types consists of taking a simple average of the last 10 days of demand data, by hour of the day, and then shifting the resulting profile up or down so that it matches the average observed load for the period 1 to 2 hours prior to curtailment. This method can be recommended for both weather-sensitive and non-weather-

sensitive accounts, with both low and high variability, for summer and non-summer curtailments.

If the default method is problematic either because of the potential for customer gaming or because of a need to curtail more promptly, the next best alternative depends on the weather sensitivity and energy use variability of the account. The default and alternatives that performed reasonably well for different types of accounts and seasons are indicated below.

Table 1
Methods for Estimating a Baseline Energy Use Profile
By Customer Account Type and Event-Specific Baseline

Season:	Summer				Nonsummer			
Weather Sensitivity:	Weather-Sensitive		Non-Weather-Sensitive		Weather-Sensitive		Non-Weather-Sensitive	
Variability:	Low	High	Low	High	Low	High	Low	High
DEFAULT Baseline Profile : 10 day average baseline load profile (BLP) plus additive adjustment based on actual energy use for 1-2 hours prior to demand response signal.	X	X	X	X	X	X	X	X
ALTERNATIVES:								
10 day average BLP plus additive adjustment based on actual load for three to four hours prior to demand response signal.			X	X			X	X
Weather model to construct BLP based on actual average outside temps when DR signal sent; diagnostics model used to deternine if building loads are suffficiently weather sensitive to use this approach.	X	X	X					
Use only the highest five of the last 10 days to construct BLP, with scalar adjustment based on a Temperature-Humidity Index load model.	X	X				X		
Use only the highest five of the last 10 days to construct BLP, without any adjustment for control day.					X			
Use the highest 10 of the last 11 days to construct BLP without adjustment for control day conditions.			X	X			X	X

Baseline load proflie- The kw demand levels for each hour of a 24 hour day averaged over the previous 10 non curtailment days

Additive adjustment: The adjusted BLP is calculated by adding a fixed amount A to the 10 day average BLP for each hour.

Demand response signal: Price or emergency signal sent to request reduced electric loads for a fixed time period

Scalar adjustment: The adjusted BLP is calculated by multiplying the 10 day average DLP for each hour by a fixed amount S.

Weather model: Hourly load data from non-curtailed days is fit by a regression model using weather and calendar variables. The BLP is the fitted model applied to the observed conditions during and after a DR signal.